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**The contributions of behaviour change science towards dental public
health practice: a new paradigm**

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Abstract

Conventional behavioural models, such as social cognition models, to improve oral health have been proposed for a long time but have failed to consistently explain reliable amounts of variability in human behaviours relevant to oral health. This paper introduces current work from the behavioural sciences aiming to better understand the process through which behaviour change may take place. Given the shortcomings seen so far in attempts to explain behaviour through traditional models it is proposed that a new approach is adopted. This commentary outlines this new approach, grounded in current work by mainstream behaviour change experts. We propose that attempts to use unreliable theoretical models to explain and predict oral health behaviour should now be replaced by work following this new paradigm.

Background

Achieving and maintaining good oral health, as well as the prevention of oral disease is critically dependent upon an individual's behaviour. There are four behaviours in particular which have been identified as critically important:

- Regular daily tooth-brushing with a fluoride containing toothpaste.
- Regular attendance at the dentist (at least once every two years or more often on the basis of their risk of developing oral disease).
- Refrain from tobacco use or quit tobacco use if the individual currently uses tobacco products.
- Reduction in the frequency of sugar containing foodstuffs, particularly sugar containing snacks between meals.

It is incumbent upon the dental care team to support healthy behaviour through the use of the most effective evidence based approaches. This is most commonly achieved as part of the consultation with the dental team and seeks to maximise patient adherence to oral hygiene advice given by the dental care professional. This paper will describe the science of behaviour change based on the latest evidence from health psychology, in order to identify the most effective approaches to maximising patient adherence to healthcare advice. Such approaches may include greater collaboration with specialist agencies outside of primary dental care to provide intensive interventions based on psychological theories of behaviour change. For example, such an approach is fairly well established in many countries for smoking cessation (1).

The role of behavioural models in supporting behaviour change in the dental setting so far

Interventions to support behaviour change tend to be more successful when theory is used rather than when it is not (2). However to date there has not been one universal model of behaviour change that psychologists can agree is the definitive one to use with any one given health behaviour. So although the need to guide clinical dental practice by behavioural science theory has been postulated (3) there

has been an absence of a clear pathway for researchers and clinicians to follow with regard to testing out these models and applying them in practice. While some authors (4) have outlined the evidence in favour of social cognition models in dental practice, critics have advised against an 'one size fits all' approach (5) and have argued that individual behaviours need to be tackled by different models, depending on the complexity of the behaviour.

This view echoes recent similar dissent in the behavioural science world. Two models that have been particularly well researched are the Theory of Planned Behaviour and the Stages of Change model. In a meta-analysis, the Theory of Planned Behaviour (TPB) has been rather poor at predicting actual behaviour (6). The TPB suggests that all behaviour is the result of intentions and that these are influenced by people's attitudes towards the behaviour, perceptions of their ability to exert control over the behaviour and subjective norms i.e. other people's ideas about the behaviour targeted for change. Convincing though it looks on paper, the theory has not lived up to its promises. For instance, in reviewing the application of popular social cognition models to behaviour change in dental settings, Renz and Newton (7) reported that whilst TPB constructs explained around 30%-50% of variability in behavioural intentions to engage in a given behaviour, this dropped to only 20-30% when the theory was used to explain actual behaviour, meaning that around 70% of behaviour could not actually be explained by components of the theory. The inability of TPB to make worthy behavioural predictions in behaviour change studies has been demonstrated very convincingly in a systematic review (8) leading to the premise (p.262) that "*the majority of behavioural intentions do not lead to behaviour change*" (9). The theory's inadequacy in being a sensible behaviour change tool has recently been extensively discussed (9, 10) leading to Sniehotta quite appropriately suggesting that we '*retire the TPB from our research for good*' (11).

Similarly, the Trans-theoretical or Stages of Change model (12) argues for an existence of unique interlinked stages supposedly underlining the readiness of a

person to engage in behaviour change. The model then purports to predict behaviour change as a function of the person's stage of change. Although the idea appears appealing, like TPB, this model has been problematic in explaining actual behaviour change. For example, in a study looking to enhance flossing behaviour, Suresh and colleagues (13) showed that stage of change was not important in predicting flossing behaviour improvement, as assessed by clinical indicators, in a diary-keeping intervention. At the same time, in work examining complex health behaviours such as engagement in physical activity, it was shown that the model was unreliable in correctly predicting people's engagement with physical activity according to stage (14).

It would appear that traditional models of behaviour change, whilst looking convincing on paper, in practice have proven rather unconvincing in actually helping us understand, research and practice behaviour change, both in dental and non-dental settings. Before concluding though that the behavioural sciences have no or little contribution to make in supporting behaviour change, we wish to put forward a suggestion for an altogether new theoretical approach to understand, support and evaluate behaviour change programmes. The suggestion builds on recent work that has been put forward by behavioural scientists working together in an attempt to conceive a minimal set of behavioural constructs that will be necessary and sufficient to underpin any behaviour change intervention. These ideas are discussed next.

A new paradigm for behaviour change

The basic principle behind this new paradigm is that behaviour change consists of three inter-related components, as seen in the COM-B model (15) (Figure 1).

----- Figure 1 about here -----

These are:

- i) *capability* (**C**) i.e. the person having the *physical* (e.g. strength) and

- psychological* (e.g. knowledge) skills to perform the behaviour
- ii) *opportunity (O)*, i.e. the *physical* (e.g. access) and *social environment* (e.g. exposure to ideas) are such that the person feels able to undertake the new behaviour
- iii) *motivation (M)* refers to the person's *conscious* (e.g. planning and decision making) and *automatic* (e.g. innate drives, emotional reactions, habits) processes said to underline the emission of any behaviour.

It is suggested that the COM-B model is a model of behaviour *per se* (15) and as such that before any change can take place the above conditions all need to be met by addressing each individual area. In dentistry for example, the consultation is very much designed to target capability by, for example, giving patients information and engaging in techniques such as Tell-Show-Do. Opportunity may not always be addressed, rather the assumption may sometimes be made that the patient's physical and social environment is such that oral health and the mouth will feature in their daily regimen. Assuming that the person has the Capability and the Opportunity to perform the behaviour, it has been suggested (15) that Motivation is the next most plausible candidate for causing people difficulties with their attempts to follow through with health-behaviour change. PRIME Theory (16) (where PRIME stands for Plans, Responses, Impulses, Motives and Evaluations) may be useful here.

PRIME theory broadly argues that people generally act in pursuit of their most basic needs / wants at that particular moment; people's beliefs about what is good or bad and any plans / goal-setting, only influence immediate actions if these goals generate sufficiently impactful, identity-driven, wants or needs that can overcome competing, automatic wants or needs arising from more direct sources such as past associations and habits. The theory would thus suggest that for someone to take on a new oral health behaviour, the behaviour needs to form part of a new, impactful identity that will be so strong, it will be in a position to overcome old, established behavioural patterns. For example, where a person

who regularly takes sugar in their coffee commits to not having sugar in order to reduce the frequency of their sugar intake, the theory proposes that this will only happen where their need to satisfy the established routine of taking sugar (perhaps fuelled by a learned association between having a hot drink and taking a brief break from work), is replaced by a fresh, new-identity-fuelled need, to be seen as a person looking after their gum health against the currently established routine.

“... what we believe to be good or bad can only influence our actions if our beliefs make us want or need things at the relevant moment. Similarly, what we intend to do at one time can only direct what we actually do if the intention is remembered and generates sufficient strong wants or needs in the moment to overcome competing wants and needs from the immediate environment... wants and needs compete at each moment for control over our actions and these are under strong stimulus control as a result of past associative learning and current drives and emotional states...” (15)(p.8).

Similarly, a person who does not visit the dentist regularly would need to overcome their pattern of seeking treatment only when in pain with a new deeply engrained new part of their identity needing to be considered as someone who takes action over their health before behaviour is triggered by the presence of symptoms – it is this new identity-driven, fresh need that has to be sufficiently strong to form a launch pad for a new behaviour.

In order to be able to support people with behaviour change and win the battle against their old, established wants and needs it has been proposed that there is a need to match the current, undesirable, behaviour pattern with the most appropriate behaviour change technique (BCT) (17). Key to this match-making process of precise behaviour with precise BCT is an understanding of the following (18):-

- i) Who needs to do what differently i.e. what behaviour needs to be changed?
- ii) What are the barriers and enablers that need to be addressed?
- iii) What particular BCTs that have been shown to be effective in overcoming the barriers and helping the enablers seen in (ii) should be used and
- iv) How can behaviour change be measured and understood?

These questions have dominated the field of behaviour change for some time. The result of intensive, expert work on reaching a consensus on what constitutes a specific BCT, how one differs from another (19) and how these can be matched to behaviours and take place within policy, has led to developments such as the Behaviour Change Wheel (17), the first version of the Behaviour Change Technique Taxonomy (19) and the Theoretical Domains Framework (18, 20).

The Behaviour Change Wheel (Figure 2) is a fairly new method for designing interventions aimed to support people in behaviour change. It consists of an identification of i) Sources of behaviour as per the COM-B model, ii) Intervention Functions (e.g. education, persuasion, training, coercions, modelling etc) and finally iii) a policy component that places (i) and (ii) within a wider societal system involving processes such as service provision, legislation etc.

-----Figure 2 about here -----

In dentistry it might be proposed for example, that for dentists to ensure that they feel enabled to routinely advise patients on smoking cessation, they should be given

- the information and psychological support to find out and feel confident in

- talking about the topic (Capability) – one aspect of this may include identifying the limits of the expected intervention, where in the case of smoking cessation dentists in primary care are typically limited to asking about smoking and making referral to specialist services;
- the chance to discuss the topic with patients within the constraints of a short consultation (Opportunity) and
 - the Motivation to engage in the behaviour (e.g. by supporting them in seeing it as part of their routine job to discuss stop-smoking ideas with patients).
- To achieve these one might need to offer education and training (Intervention Functions) and go as far as producing guidelines and regulating the everyday practice of dentists (Policy) while identifying the limit of the specific behaviour expected of the dentist.

Related to the Behaviour Change Wheel, is the Theoretical Domains Framework (TDF), a system developed by behavioural experts for use in implementing behaviour change interventions. Here, a 14-cluster system is proposed where the behavioural domain that needs targeting is stated (e.g. people's knowledge, skills, beliefs about their capabilities, emotion) and fitted within the Behaviour Change Wheel components (Table 1). Looking at the TDF domains, the behaviour that needs to be changed can be described in terms of its individual features.

----- Table 1 -----

So, where an apparently non-adherent patient with periodontal disease repeatedly attends with high plaque scores, having established that the reason for non-adherence sits within their Capability (e.g. poor oral hygiene related skills) and Motivation (e.g. poor emotional reaction to bleeding when first attempting to floss) the dental team can support behaviour change through tackling those two psychological components.

Further, recent research(19) has offered an insight into the various BCTs that are

available to support such a change showing how they may relate to or differ from each other. The 16-cluster taxonomy of BCTs thus considers processes such as effecting change through setting goals and planning, rewards and threats, feedback and monitoring and so on. The full set of BCT groupings (clusters), along with examples of specific BCTs nestling under each one cluster, as proposed by the taxonomy, appear in Table 2.

----- Table 2 here-----

How is the new paradigm different from current models of behaviour change?

It should be apparent that a completely new paradigm of thinking about behaviour change processes and supporting them in practice is emerging. Rather than proposing a model of seemingly related processes that may or may not combine to influence behaviour, as for example has been the case in Theory of Planned Behaviour and other social cognition models, current thinking suggests that to change behaviour we need to

- i) identify the behavioural component that we wish to change through the COM-B model
- ii) consider which theoretical domain needs to be tackled, by consulting the TDF and
- iii) Examine the BCT taxonomy (v1) for the appropriate BCT to select.

Work is now under way to find out which BCT is best for which health behaviour. For instance, in a recent systematic review of systematic reviews of interventions aimed to enhance healthy dietary behaviours, usually with a weight loss target, Greaves and colleagues showed that simply giving dietary advice in the absence of a BCT was not as effective as supporting people behaviourally in addition to offering dietary advice (21). In particular, enlisting the social support of family

members, establishing self-monitoring of dietary behaviour, and use of relapse-prevention techniques were effective BCTs to support the initiation of dietary changes, once these had been initiated successfully. BCTs aimed to encourage self-talk were effective in helping people maintain dietary changes. Further, high intensity interventions (i.e those including more than one BCT, more contact time or a longer duration) were found to be more effective with a positive relationship found between dietary change at 12 months and number of patient-healthcare professional contacts.

In another popular, resistant to change health behaviour, namely physical activity work has shown that for healthy adults, action planning (i.e. detailed planning of what the person will do, when and where), providing instruction on how to perform the behaviour and reinforcing their effort or progress towards the behaviour were BCTs that were associated with increases not only in physical activity but also in people's belief that they could engage in physical activity i.e. their self-efficacy. The latter technique, was also seen as helpful in the review of interventions with obese individuals (22). Obese individuals attempting to enhance their physical activity also benefitted from interventions such as keeping a record of measures influenced by the physical activity (e.g. physical fitness/ blood pressure), planning on ways to elicit social support to help them with the change in their physical activity levels, being taught to identify environmental prompts used to remind them to engage in physical activity and finally, identifying prompts to rehearse and repeat the physical activity numerous times.

Currently there is no work to show what BCT is best for enhancing health behaviours related to oral health. This is not surprising as most work in oral health is either a-theoretical or relies on, now dated attempts to use social cognition models to predict behaviour.

We suggest that this new work from the behavioural sciences arena makes a timely entry into the field of behaviour change in dentistry and that appropriate

interventions are designed, evaluated and modified in order to better understand and ultimately predict behaviour change in oral health settings.

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Figure 1: The COM-B model (adapted from Michie, van Stralen and West, 2011, p.4)

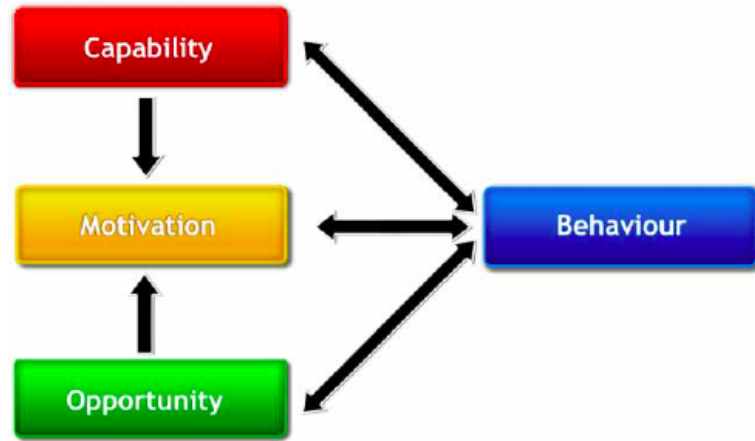


Figure 2: The Behaviour Change Wheel (adapted from Michie and West, 2013, p.12)

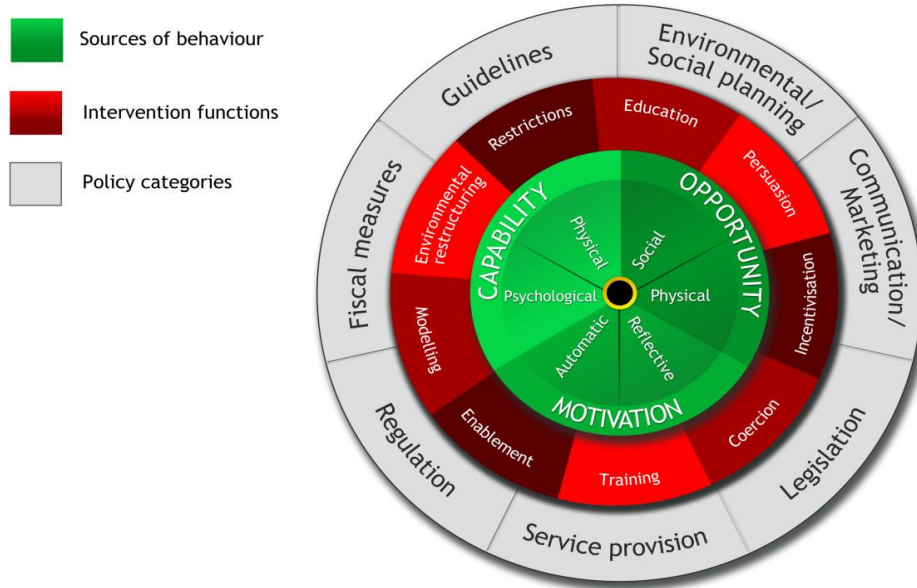


Table 1: The COM-B Model and its relation to the TDF (adapted from Cane et al., 2012, p.15)

COM-B component		TDF Domain
Capability	Psychological	Knowledge
		Skills
		Memory, Attention and Decision Processes
		Behavioural Regulation
Opportunity	Physical	Skills
	Social	Social Influences
	Physical	Environmental Context and Resources
Motivation	Reflective	Social/Professional Role & Identity
		Beliefs about Capabilities
		Optimism
		Beliefs about Consequences
		Intentions
		Goals
	Automatic	Social/Professional Role & Identity
		Optimism
		Reinforcement
		Emotion

Table 2: Summary of the Behaviour Change Taxonomy showing the 16 clusters of behaviour change and examples of associated techniques

Behaviour Change Technique Cluster	Examples of specific techniques defining the cluster
1. Scheduled consequences	Punishment, extinction, shaping, negative reinforcement, differential reinforcement
2. Reward and Threat	Social, material or self reward, non-specific reward, anticipation of future rewards or removal of punishment, threat
3. Repetition and Substitution	Habit reversal or formation, graded tasks, behavioural rehearsal / practice
4. Antecedents	Restructuring the physical or social environment, avoidance or changing exposure to cues for the behaviour
5. Associations	Classical conditioning, cues, discriminative cue
6. Covert learning	Vicarious reinforcement, covert conditioning
7. Natural consequences	Health, social, emotional consequences, salience of consequences
8. Feedback and Monitoring	Biofeedback, feedback on behaviour, self-monitoring of behaviour
9. Goals and planning	Action planning, problem / coping planning goal setting, behavioural contract, review behaviour or outcome goal
10. Social Support	Practical, general, emotional social support
11. Comparison of Behaviour	Modeling Social comparison Information about others' approval
12. Self-Belief	Focus on past successes, mental rehearsal of successful performance
13. Comparison of outcomes	Pros and cons, persuasive argument, comparative imagining of future outcomes
14. Identity	Self-affirmation, identification of self as role model, cognitive dissonance, reframing
15. Shaping knowledge	Behavioural experiments, antecedents, reattribution,
16. Regulation	Regulate negative emotions, pharmacological support, conserving mental resources